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ABSTRACT

"Making connections" is an analytic tool that promotes the search of relationships between a concept to be taught and the elements that may affect its meaning. The ability to make connections prepares students to tackle new information, to discover its basic organization, and to reduce its complexities. It adds meaning to knowledge, aids in retention, and eases transfer. Assumptions in the use of "making connections" as an instructional technique deal with the issues of prior knowledge, discovery learning, constructivism, schema theory, the dynamic nature of knowledge, creative thinking, and questioning techniques. The instructional technique of "making connections" outlines 14 elements, to focus the learner on examining a specific aspect of the concept under study and carefully looking for all possible relationships. The 14 elements include: substance, purpose, concreteness, causes, effects, relationships, variability, components, evolution, limits, similarities and differences, physical sensations, affective elements, and visual representation. Curriculum implications are listed. Two worksheets for examining the 14 elements of a concept are appended, one being a concrete version and the other an abstract version. (Contains 18 references.) (JDD)

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MAKING CONNECTIONS: AN IN-DEPTH CONCEPT TEACHING TECHNIQUE

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INTRODUCTION

Making Connections as an in-depth concept teaching technique is an analytic tool that promotes the search of relationships between the concept to be taught and the elements that may affect its meaning. These elements, among many, could include its historical development, futuristic implications, cultural variations, etc. The establishment of relationships is the main object of this instructional technique.

Analysis is an advanced level of intellectual behavior and in the critical thinking movement is considered a higher-order thinking skill. The importance of making connections in concept learning has been promoted by several educational experts. Bloom (1956) in his *Cognitive Taxonomy of Educational Objectives* defines analysis as "the process of breaking down complex information into its essential elements, making explicit the relationship among elements and recognizing the organizational principle that holds together the communication". Relationships between concepts are also important. Gagné, (1965) in his *Intellectual Skills Taxonomy*, introduces his "principle learning." He defines it as "explaining the relationships among various

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concepts to form a generalization." The ability to make connections and to discover relationships is basic, then, for any learning to happen. This way of thinking prepares students to tackle new information, to discover its basic organization, and to reduce its complexities. It adds meaning to knowledge, aids in retention, and eases transfer.

THEORETICAL BACKGROUND

Making connections as an instructional technique has seven basic assumptions of cognitive theories. The first assumption is the importance of prior knowledge in the acquisition of new information. Ausubel (1968) defines meaningful learning as "the one that relates new information to knowledge already possessed by the student". This fact calls attention to the importance of connecting what is to be learned with what the learner already knows. **Making connections**, as an instructional technique, requires the student to relate the new concept to a variety of his-her own ideas and experiences. He/she will use thinking skills such as, ordering, comparing/ contrasting, classifying, inferring, logical reasoning, etc. as the basis for problem solving and decision making. The components of the technique can be used as advanced organizers.

The second assumption is based on discovery learning (Bruner, 1983). In this approach the students arrived at their own solutions to problems. This practice helps them to learn *how* to learn becoming better problem solvers. At the same time they

gain confidence in their learning abilities and therefore developing a tendency to function later in life as problem solvers. **Making connections** as discovery learning enables the student to understand the many ways ideas connect to one another, to become independent problem solvers, and to find how their knowledge is relevant to what they learn. Once they dominate the fourteen components of the technique they can apply them to any other concept or situation.

The third assumption has been taken from the contemporary view of meaningful learning: constructivism (Bednar, et. al., 1991). In this approach the learner builds his/her knowledge structures from personal experiences. The students should view the ideas and problems from multiple perspectives. **Making Connections**, as a technique provides for the achievement of this objective by provoking the students to see an important idea in its complexity and to develop an understanding of it.

A fourth assumption from cognitive psychology is the organizational aspect of knowledge. Most cognitive theorists believe that our storage of information in long-term memory is organized in form of schemata. A schema, according to Piaget (1954) "is a cognitive framework in which knowledge is stored in an intricately related structure." According to schema theory, information is organized in such a way that the activation of one bit of information in a schema activates related information in other mental structures. A schema has various functions in the process of learning. It

helps in the assimilation and accommodation of new information, provides a basis for inferring, and aids in the recall of information already stored in the mind. **Making Connections** builds schemata as it organizes both prior and new knowledge in an interrelated network under the guidance of teachers' high level questioning and suggested categories of possible connections.

A fifth assumption that gives basis and support to **Making Connections** as an instructional technique is the cognitive premise that considers knowledge as dynamic, that is, it is in constant state of change. This involves the continuous assimilation of new information to existing schemata and the accommodation or modification of existing knowledge basis. With **Making Connections** as an instructional technique the teacher will help students create new schemata if the class topic is a new concept always assuring that the new structure is sufficiently interrelated for easy access. On the other hand, the student can refine and expand an existing schema as he/she relates it to new and novel situations.

A sixth assumption to consider is the fact that seeking internal and external connections to already learned information improve its understanding and facilitates its transfer to new situations (Mayer, 1975, 1989). **Making Connections** as an analytic tool stresses the establishment of linkages and relationships, within a conceptual framework, between the subject content and the student's experiences beyond the

classroom.

As a seventh assumption it can be stated that the creative act is the outcome of a careful examination of relationships and possibilities. The creative act has antecedents although they are not explicitly present at the creating moment (Domínguez, 1991). These antecedents can be information already stored in the brain, and so interrelated with other pieces of information that being conscious of one activates the other. The creative aspect of **Making Connections** is seen in its emphasis on looking at the concept from a futuristic standpoint, that is, considering the possible future development and implications of the concept under study. An added benefit to the use of **Making Connections** in the classroom is its value as a promoter of creativity. According to Halpern (1984) creative thinking is "the ability to form a new combination of ideas to fulfill a need." Perkins (1984)stated that it is "to generate original and otherwise appropriate results by the criteria of the domain in question." **Making connections** requires students to go beyond the information at hand and to think of the concept in other contexts in time.

Guilford (1959) identified three distinctive areas of divergent thinking within the creative activity and its development: fluency, the rate of production of new ideas; originality, that is, the extent of the uniqueness of the ideas as it applies to the situation and; flexibility, the reorganization of knowledge in a new conceptual schemata. Other

authors (Pasch, 1991) identify elaboration or the ability to apply the novel ideas to new situations as the fourth element of creativity. **Making Connections** as an instructional technique provides for the development of Guilford's areas. Fluency is attained as the technique calls the student to make as many connections as possible. Originality is promoted as students search for novel connections and by the process of insight hitting upon ideas that are unique to the situation under scrutiny. Flexibility is achieved as students reorganize their cognitive schemata. Elaboration, the last area of creativity is brought about by the application of new connections in daily problem solving of life situations.

The eighth and last assumption is the impact of questioning on learning outcomes. Taba (1964) found that the level of questioning by teachers was a very important factor in the cognitive development of students. Other authors have found that teachers establish the level of thinking in their classroom by the level of questioning they maintain (Gallagher and Aschner, 1963; Arnold, Atwood, and Rogers, 1973). **Making Connections** provides a line of questioning that is characterized by its open-endedness and divergence nature, allowing thus the development of both critical and creative thinking.

THE TECHNIQUE

The technique has fourteen components or elements. Each asks the learner to look at a specific aspect of the concept under study be it an idea, an object or a subject. Each component is carefully analyzed looking for all possible relationships.

The technique asks the student to go deeply into a concept through questioning. The levels of the questions will make the difference in the superficial or complicate meaning and treatment of the concept under study. To illustrate the technique the concept mammal is being used.

The following are the components.

Substance

According to Webster Dictionary substance refers to "that which exists by itself and in which accidents or attributes inhere." Questions such as the following will lead to develop the concept. "What is it? Define it. At this point this definition should be written. It will serve as a frame of reference through the study of the concept. What is it without which the concept will not be the same thing? What is it for? In a practical way it refers to the mental category in which the concept belongs. The substance of mammals as a concept refers to a category of animals.

Purpose

What does it exist for? Why was it developed? What is expected from it?

Which will be the ideal state of it? Here the student will refer to the reason for its being. In the case of mammals the student could refer to its place in the evolutionary process, its role in the food chains, etc.

Concreteness

This is its material expression. Of what is it done if it is an object or a living thing? Of what other things could it be done? Is it simple or compound? Is it natural or made by someone? Following the use of mammal's example the student is asked to cite examples of them.

Causes

These are the justifications for its existence. Are these causes natural, artificial, volunteer, or by casualty? Each of the possible causes is analyzed separately. Concept mapping or any other teaching technique can be used for the analysis. The student here tries to explain, perhaps, philosophically, the situations that made possible the appearance of mammals.

Effects

These are the consequences of its existence. Which natural, artificial, primary or secondary effects can be identified? Each type of effect is analyzed separately. Concept mapping or any other teaching technique can be used to this part. As an example: "Which are the results of having mammals upon the earth?

Relationships

Are these relationships essential, accidental, logical or imposed? These are studied separately. The student is asked to make connections with other conceptual realities. In the example these connections might be with other animals, plants, the ecosystem, etc.

Variability

Different forms of expression. Is it material, ornamental, traditional or possible? These aspects should be studied individually. What types exist and in what forms? In what other forms could it exist? This component asks the student to look the concept in a futuristic and creative way. For example: "In how many ways are mammals present today on the biosphere? Is it possible to have other types of mammals?

Components

These are the parts inherited to the concept. How many parts does the system contain? Are these parts divisible? If yes, in how many parts can it be divided? Are these parts essential or could they be substituted? Are these parts accidental? Can they be reduced? What other components could it have? In this instance the student is asked to use his (her) imagination and creativity. A student could mention that the species mammal counts of a number of systems (muscular, digestive, etc.) and organs.

Evolution

These are the changes in time. Which is the present state of the concept, subject or object? How was it at the beginning? How could it be in the future? In thirty years? In a 100 years? Example: How have mammals changed through their history? Which changes you think will occur along future time? The student can use his (her) imagination to present the ideas. They can be supported by some type of research and/or speculation.

Limits

This element can be studied looking quantity, size, order, place and exceptions. This is, those aspects that put limitations to any thing. The following questions can be explored. "Does it exist in numbers? If so, how many can you identify? In terms of size, is it small, big, wide, huge, scarce, abundant, etc. Does it need a specific order? If so, is it internal or external order? Does it need to be in harmony with other things? If so, which things. Is it universal? Are there any exceptions to the concept, object or subject? What are the characteristics of mammals that are important for its survival as mammals, in other words, to avoid extinction.

Similarities and differences

How does it look like? With what can you compare it? Is it different to what? What characteristics mammals share with reptiles, or birds, etc.

Physical Sensations

Which senses do the concept appeals? Describe the sensations. Try to use all available senses. Can you think of the smell of a cow? Describe. This line of questions is typical for this component.

Affective elements

Which emotions and attitudes arise related to the concept? Describe them. Describe a time in your life when a mammal was important to you. Describe your emotions (fear, joy, happiness, etc.) related t an incident in your life in which you were involved with a mammal.

Visual representation

This element is the image or pictorial expression of the concept. In an abstract concept this may serve to make the idea as concrete as possible.

It is important that after the first general discussion the students should revise their first definition.

APPLICATION OF THE TECHNIQUE

In the development of the class the learning cycle (exploration, conceptualization and application) could be followed. This instructional strategy is the ideal for the implementation of **making connections.** In the exploration phase the first general

discussion of the concept will be done by using the previous knowledge of the students. Afterwards the group will identify which components they master, of which ones they do not have any or only some knowledge, and which ones need to be re-studied in depth according to the objectives. This exploration should result in the establishment of the learning objectives of the next phase of the learning cycle. A working definition should arise as a basis for comparison as the process continues and new knowledge is attained.

In the conceptualization phase **making connections** can be complemented by several supporting techniques or methods can be used to complete the process. The components of the technique can be used as an outline that can be filled out and revised in several classes after research, group work, readings, lectures, films, demonstrations, simulations, concept mapping, oral presentations and other devices have been used. The students can be organized in cooperative groups to study and elaborate the concept. Different components are assigned to the different groups so that each has to make a specific contribution for the success of the whole group. After the activities the definitions are compared to assess conceptual expansion, clarifications, substitutions done, reductions and so forth.

For the application phase a concept mapping will be ideal, using the different components to illustrate the relationships among them. Some pieces or the complete

work can be part of the portfolio of the student.

Other valuable ways to use the technique is as an assessment tool. Such innovative techniques such as comic strips, illustrations, poems, essays or paragraphs for the integration of the whole learning experience. A reflective diary can be written around the major learning after studying the concept in depth. Some of the pieces produced will be part of the portfolio.

Because as far as the technique asks for in depth analysis of the concept, its use is highly recommended to develop mastery of the major concepts of any discipline.

CURRICULUM IMPLICATIONS

The technique can be used for different purposes such as

1. Teaching a new concept.
2. Expansion of an already taught concept.
3. Basis for writing essay questions.
4. Interdisciplinary teaching.
5. Concept mapping.
6. Staff development activity.
7. Curriculum development.
8. Creative writing.

The reader may devise other applications for the technique.

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AN INSTRUCTIONAL TECHNIQUE TO DEVELOP THINKING SKILLS

MAKING CONNECTIONS
Concrete version

A. Sánchez
L.E. López

PURPOSES:

1. to develop analytical skills.
2. for teaching a new concept or the expanding of a previously learned concept.
3. to teach with an interdisciplinary approach.
4. to promote creativity.

CONCEPT:_____

1. Its Substance
   a. Essence: What is its nature?

   b. Essential attributes:
   Which characteristics make it what it is?

   c. Accidental attributes:
   Which characteristics are secondary to its nature?

   d. Write a definition:

2. Its purpose.
   a. What is it intended for primarily?

   b. What other uses could it normally have?

   c. What other uses could you think of?

3. Its concreteness.
    a. What is it made of?

    b. What else could it be made of?

    c. How would it be in the future?

4. Its causes.

    a. Who made it or who makes it?

    b. Why is it made?

5. Its effects.
    a. What does it produce?

    b. Are its effects good or bad, and why?

6. Its relationships.
    a. With living things.

    b. With other things.

    c. Within a system.

7. Its variability.
    a. How many different forms of the concept exist?

    b. What other forms could be conceived?

8. Its components.
    a. How many parts does it consist of?

    b. Why are its parts necessary?

    c. What other parts could it consist of, that are not counted among the necessary ones?

9. Its evolution.
    a. How was it originally?

    b. How is it now?

    b. How could it be in the future?

10. Its limits.
    a. Differences and similarities with other concepts as far as form, space, size, number, location, etc.

11. Physical sensations.
    a. Describe some of the physical sensations that accompany your perception of an object that represents the concept.

12. Affective elements.
    a. feelings

    b. emotions

    c. attitudes

13.Its visual representation.
    a. Draw a picture or any visual representation that represents what the concept means to you.

Re-write a definition:

AN INSTRUCTIONAL TECHNIQUE TO DEVELOP THINKING SKILLS

MAKING CONNECTIONS
Abstract version

A. Sánchez
L. E. López

PURPOSES:

1. to develop analytical skills.
2. for teaching a new concept or the expanding of a previously learned concept.
3. to teach with an interdisciplinary approach.
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CONCEPT:_____

1. Its Substance
   a. Essence: What is its nature?

   b. Essential attributes:
   Which characteristics make it what it is?

   c. Accidental attributes:
   Which characteristics are secondary to its nature?

   d. Write a definition:

2. Its purpose.
   a. What is it intended for primarily?

   b. What other uses could it normally have?

   c. What other uses could you think of?

3. How can it be concretized?

4. Its origin.
   a. What is the historical explanation of its origin?

   b. Why was it originated?

5. Its effects.
   a. What good does it produce?

   b. Are its effects good or bad? Explain

6. Its relationship with humans.
   a. What persons intervene with this concept?

   b. For whom is it real?

7. Its variations.
   a. How many different types exist?

   b. What other forms could be conceived?

8. Its parts.
   a. How many parts does it consist of?

   b. Why are its parts necessary?

9. Its evolution.
   a. How was it originally?

   b. How it is now?

   c. How could it be in the future?

10. Its limits.
    a. It should not be confused with:

    b. It´s similar to_____ in ....

11. Physical sensations.
    a. Describe some of the physical sensations that accompany your perception of something that represents the concept.

12. Affective elements.
    a. What feelings arise the concept?

    b. What emotions do you feel?

    c. What attitudes can you identify in relation to the concept.

13. Its visual representation.
    Make a drawing of the mental image of the concept.

Re-write a definition: